

Business Experimentation and Causal Methods

Prof. Fradkin
Topic: Advertising Experiments



This Time

A very short overview of advertising.

Key concepts:

- Why advertise?
- ROI (Return on Investment)
- Opportunity Cost

Why Advertise?

- Inform people about your product.
 - Persuade people to use your product.
 - Remind them that your product exists.
 - Provide value to users of the product by generating social status for them.



How Does Advertising Happen?

US Total Media Ad Spending Share, by Media, 2014-2020

% of total

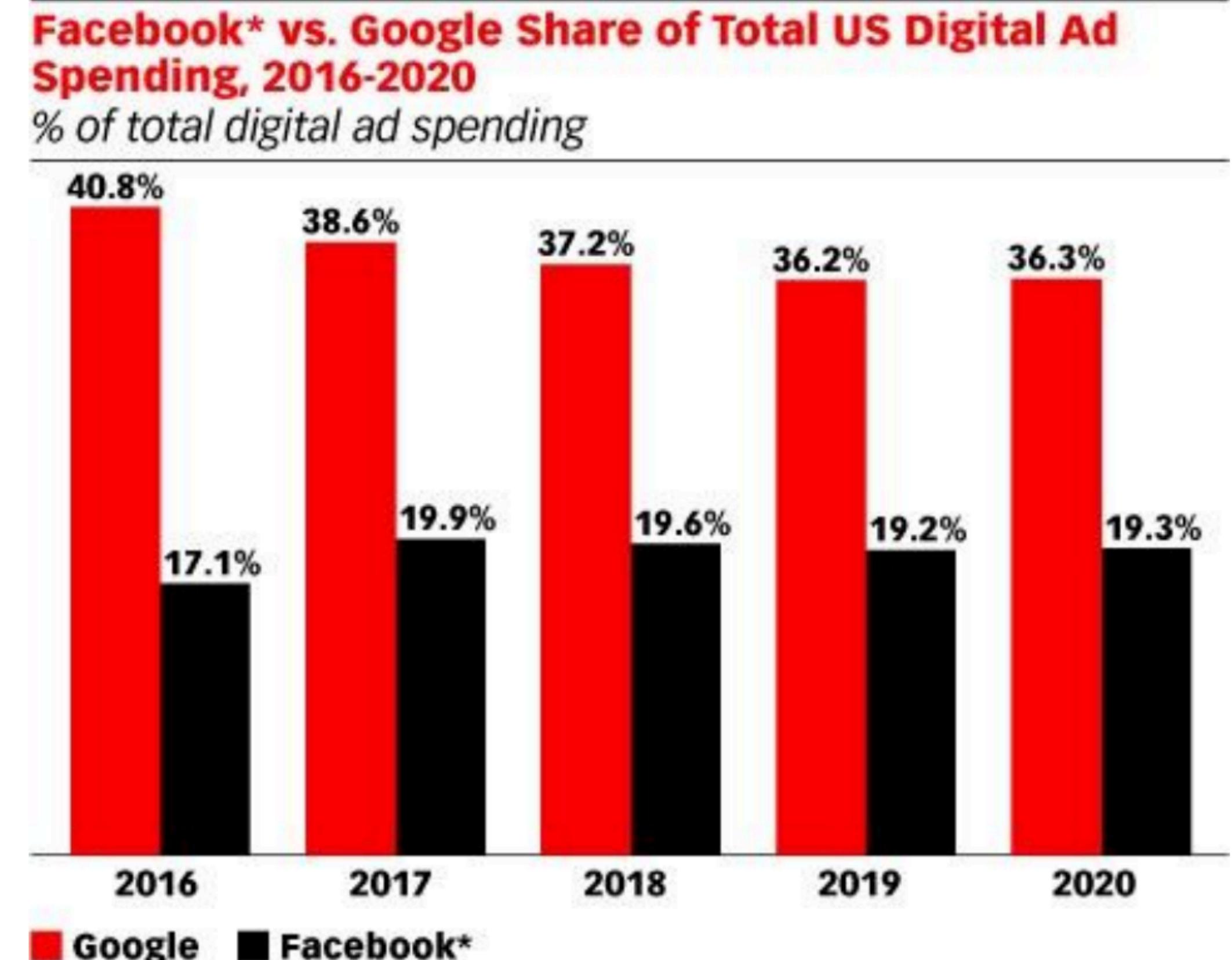
	2014	2015	2016	2017	2018	2019	2020
TV*	39.1%	37.7%	36.8%	35.8%	34.8%	33.7%	32.9%
Digital	28.3%	32.6%	35.8%	38.4%	40.8%	43.1%	44.9%
—Mobile	10.9%	17.3%	22.7%	26.2%	28.8%	31.0%	32.9%
Print	17.4%	15.4%	13.9%	12.9%	12.2%	11.6%	11.1%
—Newspapers**	9.1%	8.0%	7.2%	6.6%	6.1%	5.7%	5.5%
—Magazines**	8.3%	7.4%	6.8%	6.4%	6.1%	5.8%	5.6%
Radio***	8.4%	7.8%	7.4%	7.0%	6.7%	6.4%	6.1%
Out-of-home	4.0%	4.0%	3.9%	3.8%	3.7%	3.5%	3.4%
Directories**	2.8%	2.5%	2.2%	2.0%	1.9%	1.7%	1.6%

Note: *excludes digital; **print only, excludes digital; ***excludes off-air radio & digital

Source: eMarketer, March 2016

Digital Advertising in 2019 in the US

- \$103 Billion spending.
- Mobile is bigger than desktop— 75% of digital advertising.
- Display advertising is about 51% of mobile ads and search advertising is 43% of mobile ads.
- Video advertising (e.g. Youtube) is about 1/3 of display advertising.
- Google, Facebook, and Amazon intermediate most digital advertising.



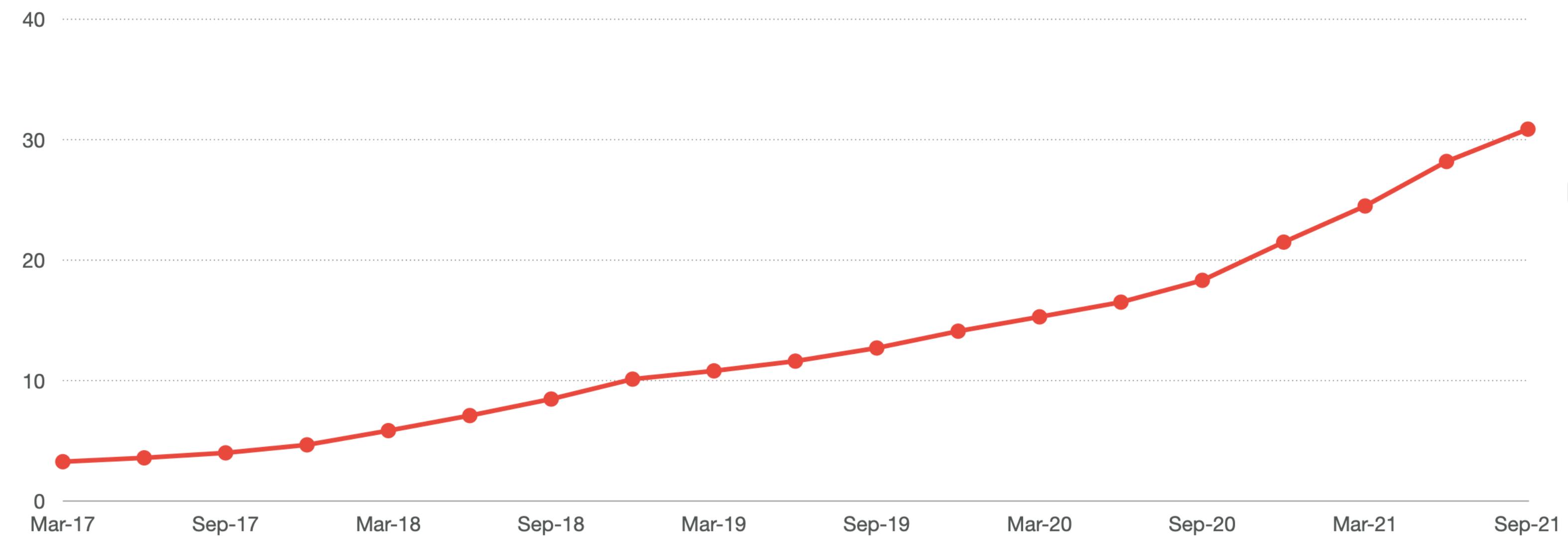
*Note: includes advertising that appears on desktop and laptop computers as well as mobile phones, tablets and other internet-connected devices, and includes all the various formats of advertising on those platforms; net ad revenues after companies pay traffic acquisition costs (TAC) to partner sites; *includes Instagram ad revenues*
Source: eMarketer, March 2018

Amazon ad revenues

New channels have new toll booths

'Merchant media' - Amazon has >\$25bn of ad revenue, possibly producing more cash than AWS

Amazon 'other, predominantly ads' revenue, TTM (\$bn)



Search Ads

chair

All Images Shopping News Videos More Tools

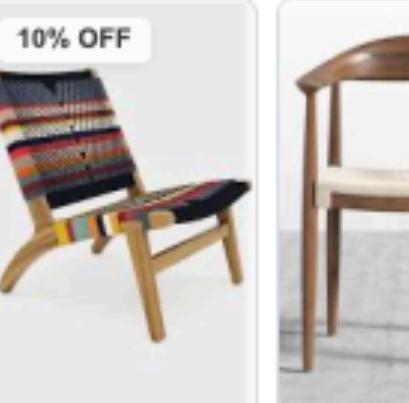
About 2,890,000,000 results (0.73 seconds)

Results for Cambridgeport, Cambridge · Choose area ::

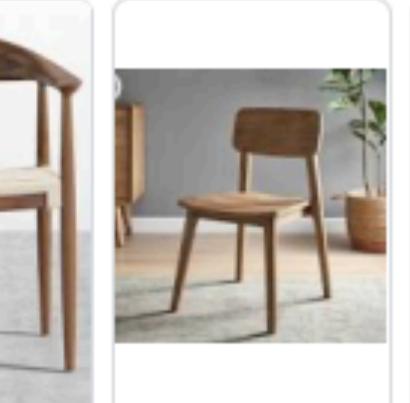
Ads · Shop chair



Ergonomic Chair | Office Chair
\$349.00
Branch
★★★★★ (3k+)



10% OFF
Teak Masaya Lounge Chair
\$850.00
Masaya & Co.
\$765 with c...



Luxury Wood Armchair -
\$424.00
Rove Conce...
★★★★★ (70)



Solid Acacia Wood Chair,...
\$518.00
Castlery
Free gift w...



Scandinavian Dining Chair...
\$249.00
Rove Conce...
★★★★★ (424)

»

Images for chair

wood office plastic modern living room



Product



Product



Product



Product



Product



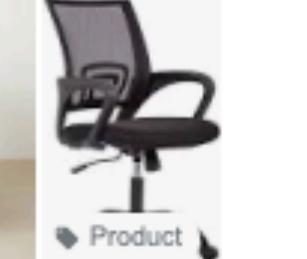
Product



Product



5+ stores



Product

stapler

All EN Hello, Andrey Account & Lists Returns & Orders Cart

ime Video Amazon Basics Best Sellers Groceries Customer Service Buy Again Gift Cards Today's Deals Prime Health & Household Amazon Launchpad Amazon Home Coupons

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ARROW The right stapler for the job Shop Arrow Fastener Co., LLC



Arrow T50 Heavy Duty Staple Gun for Upholstery, Wood, Crafts, DIY and Professional Uses, Manua...
★★★★★ 3,666
prime



Arrow T25 Heavy Duty Staple Gun for Low Voltage Cables and Wires up to 1/4-Inch Diameter
★★★★★ 922
prime



Arrow JT21CM Professional Light Duty Staple Gun for Upholstery, Crafts, Office, Fits 1/4", 5/16", o...
★★★★★ 621
prime

RESULTS

Amazon's Choice



Amazon Basics Stapler with 1000 Staples, for Office or Desk, 25 Sheet Capacity, Non-Slip, Black
★★★★★ 37,927
\$7.19
\$6.83 with Subscribe & Save discount
prime
FREE delivery Mon, Jan 30

Featured from our brands

Amazon Basics Stapler with 1000 Staples, for Office or Desk, 25 Sheet Capacity, Non-Slip, Black
★★★★★ 37,927
\$7.19
\$6.83 with Subscribe & Save discount
prime
FREE delivery Mon, Jan 30

Sponsored

Swingline Stapler, 747, Classic Desktop Stapler Heavy Duty, 30 Sheet Capacity, Portable, Durable...
★★★★★ 4,920
-63% \$15.78
\$42.69
prime
FREE delivery Mon, Jan 30

Sponsored

Deli Effortless Desktop Stapler, 40-50 Sheet Capacity, One Finger Touch Stapling, Easy to Load Ergonomic...
★★★★★ 11,648
-6% \$16.99
\$17.99
prime
FREE delivery Mon, Jan 30

Sponsored

Swingline Stapler, Optima 25, Full Size Desktop Stapler, 25 Sheet Capacity, Reduced Effort, Blue/Gra...
★★★★★ 7,304
-63% \$15.19
\$41.39
prime
FREE delivery Mon, Jan 30

Amazon Basics Stapler with 1000 Staples, for Office or Desk, 25 Sheet Capacity, Non-Slip, Black
★★★★★ 37,927
\$7.19
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Display Ads



21, 2020

ENGLISH ESPAÑOL 中文

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JETSETF.COM

A photograph of a modern airport terminal with a high, curved ceiling featuring a large glass window. People are walking through the terminal, and there are various signs and kiosks visible. The text "JETSETF.COM" is overlaid at the top left of the image.

How are digital ads priced?

- Cost per click (CPC)
- Cost per thousand impressions (CPM)
- Cost per action (CPA)
 - For example, if the customer adds the advertised item to the checkout cart.
- Negotiated placements.

Auctions for ads

- A company - let's say Allbirds - submits a bid (CPM, CPC, CPA) for users of a particular type - say men in the age range of 20 - 30 residing in Boston.
- Other companies submit bids.
- Advertising platform runs an auction for each advertising slot. Highest bidder (weighed by ad quality) wins.
- Much more nuance, variety, and complexity here.

“Half the money I spend on advertising is wasted; the trouble is, I don't know which half.”

- John Wanamaker

What are we trying to optimize?

- We are trying to optimize our return on investment (ROI).
- Our investment is the amount of money we spend on ads.
- What is our return?
 - Company should care about **profits**.
 - Profit: Revenue from products sold minus the cost of producing those products.
 - Margin: Share of revenue that is profit.



Important Warning

We can't just calculate profit from the people who saw an ad!

These people may have purchased even without seeing an ad.

This is why we need an experiment!

The ROI Formula for the Treatment Group

$$\frac{\beta m - c}{c}$$

Causal Effect on Revenue per Person

Margin

Advertising cost per person

The diagram illustrates the components of the ROI formula for the treatment group. The formula is $\frac{\beta m - c}{c}$. Three arrows point to it: one from 'Causal Effect on Revenue per Person' (top left), one from 'Margin' (top center), and one from 'Advertising cost per person' (bottom right).

Note, this excludes the cost of the control group.

Multiply top and bottom by treated participants.

$$\frac{\beta m - c}{c}$$

$$= \frac{\text{Total Causal Change in Profit} - \text{Total Cost of Ads in } T}{\text{Total Cost of Ads in } T}$$

ROI of Experiment / Campaign

- For some experiments, we also need to pay for impressions in the control group. This may occur if they are seeing ‘placebo ads’.
- In that case, we can also calculate the ROI of the experiment.

$$\frac{\text{Change in Profit} - \text{Total Cost of Ads for Exp.}}{\text{Total Cost of Ads for Exp.}}$$

- Additional benefit of experiment, we learn whether we should run the ad in the future. Not captured in ROI formula.

What ROI Estimates Often Miss

- Fixed costs of setting up the campaign.
- Spillovers from advertising -> I may tell you about the great product I purchased.
 - This is a violation of non-interference. May be important in some cases.
- Long-run effects.
 - You may be shifting purchases forward that would have occurred in the future.
 - You may have caused more future purchases (as in a subscription billed monthly).
- Effect on ‘Brand Reputation’

Opportunity Cost

- Suppose we know that advertising has a positive ROI.
 - This is rarely true!
- Then having a control group will lose us money.
- Opportunity Cost: The amount of money we lose from having a control group.
- We may still want to run an experiment.
 - Interesting to know what the ROI is.
 - Helps with targeting.
 - Can experiment to determine which ad is best.

Concepts

- Ads are very important for the digital economy.
- Measuring the causal effect is necessary to calculate the ROI (return on investment).
- Opportunity cost.